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Systems Sciences Laboratory

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ABSTRACT

The TLCAC study, conducted during January 2001, involved two military and three civilian teams conducting planning activities under time constraint and fighting a battle with a designated enemy using the Janus wargame. This report outlines the planning behaviours observed in military and civilian participants, and briefly discusses their possible relation(s) with the wargame outcomes. It is concluded that the current behavioural results show a stronger association with the Recognitional Planning Model than the military appreciation process, indicating a need for further work in the area and a consideration of the foundation model of planning used.

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Fax: (08) 8259 6567

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Executive Summary

The planning aspect of this study had two aims:

- to elucidate typical planning behaviours under time-constrained circumstances, and
- to attempt to establish the existence of a relationship between the levels and types of behaviours being displayed by participants, and a simple performance measure from the Janus wargame.

The participant teams were given 20 minutes prior to each wargame session to plan their course of action, and these activities were videotaped and later scored using behavioural checksheets. The levels and types of behaviours were then collated and illustrated graphically in order to display trends in the data. The teams' outcomes - in terms of a basic measure of performance (i.e. the kill/loss ratio) – were compared with the behavioural data and trends examined.

It was concluded that there were no strong trends in the data in this instance, from the perspective of behaviour and the simple performance measure. It is suggested that future work include attempts to incorporate the behaviour systems approach and refinement of the method of examining the insertion of technology into the military battle or planning situation, in addition to consideration of the effects of the introduction of information technology to the military workplace. It is also shown that the Recognitional Planning Model (RPM) better represents the behaviours displayed by participants during the planning phases of the experiment than the military appreciation process. This indicates a need to consider the more flexible and dynamic RPM model as the basis for future planning training.

This report details one of the first of a series of experiments intending to explore the enhancement of military functioning through the use of new tools and technologies. The tools and technologies are currently being developed: there is a need to discover effective and successful methods of introducing these tools to the military in order that their current level of functioning not be adversely affected. Overall then, the aim is to benefit the military customer via researching an effective method of integrating new tools, achievable through a developing series of research methods and experiments.

Authors

Monique Kardos
Land Operations Division

Monique Kardos completed a Bachelor of Science with honours in Psychology in 1994, and a PhD (Psychology) in the field of Animal Learning and Behaviour at Adelaide University in 1999. She has taught Psychology to undergraduates at Adelaide University and University of South Australia, and has undertaken research field trips with both the Department of Environment and Natural Resources, and the Adelaide Zoo. She joined DSTO as a research scientist in March 2000, working with the HSI discipline. She is currently working for the Force Operations Analysis and Battlespace Awareness tasks, focusing on the analysis of current operations, examining HMI issues as part of the development of SA tools and evaluating the effects of these tools on Army operations, and contributing to the evaluation of ARH tenderers' responses as part of the AIR 87 acquisition project. She has recently returned from East Timor where she examined both the MGI capability and information management issues in 2nd Battalion Group during their deployment.

Taryn Chapman
Land Operations Division

Taryn Chapman completed a Bachelor of Arts with honours in Psychology in 2000. She joined DSTO in November 2000, working in the HSI discipline. She is tasked to the Human Factors Battlefield Command Support System evaluation task. Specifically her role is to research human factors issues, such as decision modelling, decision error, and human biases in decision-making. She has presented work at various national conferences, such as the Land Warfare Conference (2001), and the Australasian Social Psychology Conference (2002). She is currently studying towards a PhD at Adelaide University, undertaking research in the field of naturalistic decision-making.

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Glossary

AI	Area of Interest
AO	Area of Operations
BCSS	Battlefield Command Support System
C2	Command and Control
CCIRs	Commander's Critical Information Requirements
COA	Course of Action
COG	Centre of Gravity
COMD	Commander
ConOps	Concept of Operations
CSS	Combat Service Support
DE	Decisive Event
DICE	Distributed Interactive C3I Effectiveness
DSO	Decision Support Overlay
DP	Decision Point
FoA	Freedom of Action
FRAGO	Fragmentary Order
HQ	Headquarters
IPB	Intelligence Preparation of the Battlefield
Int	Intelligence
IT	Information Technology
MAP	Military Appreciation Process
MCOO	Modified Combined Obstacle Overlay
MPG	Mission Planning Guide
NAI	Named Area of Interest
OODA loop	Observe Orient Decide Act loop
OpOrd	Operation Orders
R & S	Reconnaissance and Surveillance
RPM	Recognitional Planning Model
TAI	Targeted Area of Interest
WG	Wargame
WNGO	Warning Order

1. Introduction

A prince or general can best demonstrate his genius by managing a campaign exactly to suit his objectives and his resources, doing neither too much nor too little.

On War
General Carl von Clausewitz

Doing 'just the right amount' of work to achieve military goals in the warfighting situation is the product of an effective planning process, and the processes involved in the planning of military missions are of interest to the Defence science community for several reasons. As one of the main aims of Defence science work is to give our own military the opportunity to stay inside the enemy Observe, Orient, Decide, Act (OODA) loop, the opportunity to make the planning process more efficient via the provision of technology and new techniques is currently being explored in detail. This is particularly important for forces such as the Australian Army since their emphasis on manoeuvre rather than the power of a large military force is what is intended to give them the 'edge' in situations of war.

The Military Appreciation Process (MAP) is the doctrinal planning method for the military and is represented diagrammatically in Figure 1.

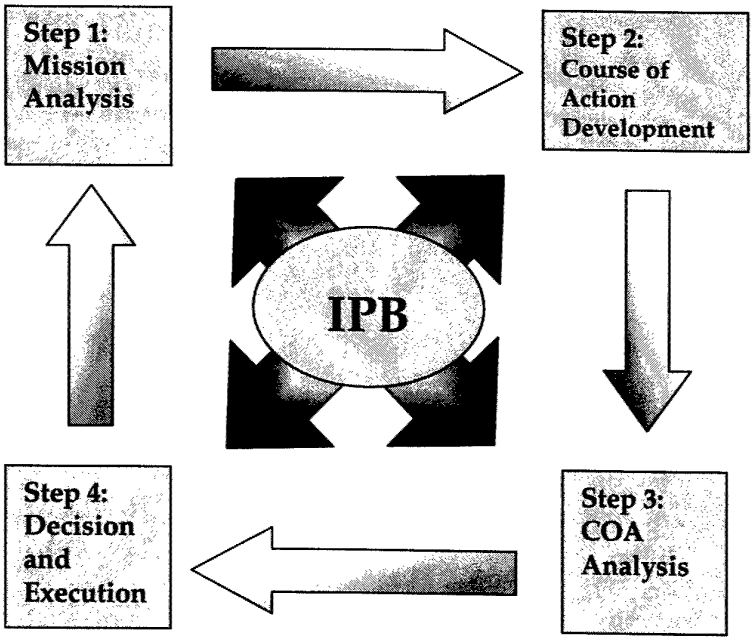

Figure 1: The essential steps of the MAP

The Deliberate MAP - as laid out in the relevant ADF training pamphlet - is a very detailed and time-consuming process which may take up to several days to complete. When military units are in a time-critical environment (eg. in the heat of battle, or when there is known to be a limited amount of time to plan for coming events), the MAP may be shortened to either the Quick MAP or the Combat MAP process in order to achieve effective planning within the allocated time limits. As this excerpt from the MAP training PowerPoint Presentation (Baumgart, 2000) shows, each of the three MAP methods has a particular set of characteristics associated with it.[1]

1. *The Quick MAP*
   - Occurs during a combat or crisis situation
   - Is characterised by very short time availability
   - Has minimal staff involvement
   - Uses intuitive judgement and Situational Awareness as compensators for the lack of planning time

2. *The Combat MAP*
   - Occurs during combat
   - Has time constraints, but not as severe as for the Quick MAP
   - Is characterised by increased Situational Awareness
   - It requires the results of the Deliberate MAP process

3. *The Deliberate MAP*
   - Has long planning times
   - Deals with circumstances that are not time sensitive
   - Involves detailed analysis
   - Explores a wide range of options
   - Utilises maximum staff involvement
   - Is a starting point for future operations

A vital part of the MAP is the Intelligence Preparation of the Battlefield (IPB), which also follows a series of steps, as outlined in Table 1. It is a continuous process, and is integral to the MAP in terms of updating the situational information provided to the planners.

In the deliberate MAP, the steps to be followed by planning staff are set out in detail. It is designed to form a single decision-making process which can be adapted to all requirements (Haub, Johnson, Goodman, Lorke, and Krieg, 2000), and is designed to take the planner from the situation they are currently in through to the desired mission endstate. Because of the complexity of the work domain and the potential for individual differences in planning abilities to affect the outcome of the planning process, it has become highly doctrinalised (as shown in the MAP diagram, Figure 1) (Pew and Mavor, 1998).

[1] Refer also to ADFP 9 (Chapter 3: Military Strategic Planning and Chapter 4: Planning at the operational Level: Campaigns and Operations) for further detail.

Table 1: Steps in the IPB process and the products of each step

Steps	Products
1. Define the battlefield environment	1. Area of Operations (AO)/Area of Interest (AI)/Battlespace [geography, terrain, weather, demography, political, socio-economic, infrastructure, etc]
2. Describe the battlefield effects	2. Identifies the full effects of environment [terrain, weather, other factors] on the friendly and enemy forces and displays them on a MCOO (Modified Combined Obstacle Overlay)
3. Evaluate the threat	3. Threat capability of enemy, Centre of Gravity (COG): establish threat doctrinal overlay and actual capabilities.
4. Determine threat COAs (Courses of Action)	4. Range of threat COAs [most likely or dangerous COAs, priorities for Intelligence (Int) collection and targeting]

The MAP is set out as a series of process stages that include a breakdown of the timings to be spent on each of the planning and preparation phases (generally a 1/3:2/3 breakdown), and assumes a relatively linear conduct of processes. It is apparent from observations of actual planning behaviours by military staff in experimental situations that conditions of linearity may not be met. In addition there may well be a way to improve the tempo of the planning process overall and account for the time-constrained planning situations which are commonly found in the military context. To this end the research is designed to explore the planning behaviours exhibited by military and civilian teams, particularly when conducted under severe time constraints.

1.1 Behavioural taxonomy of the MAP

The behavioural taxonomy used for the purposes of this experiment can be found in Table 2. It does not include full details of the complete IPB process, as there was no true IPB input for the purposes of this study.

Table 2: The basic behavioural taxonomy for the MAP

Category	Sub-category	Behaviours
Mission Analysis	*Review situation*	Utilise IPB update: consider environment, threat information, enemy Course of Action (en COA), en Centre of Gravity (en COG), en Decision Points (en DPs)
		Consider & utilise information about: own COG, critical vulnerabilities, state of manoeuvre, log capabilities, morale, assets, CSS assets & capabilities
		Perform time analysis for key timings, distances, assembly/preparation times, duration, & planning time
	Identify and analyse superior commander's intent & mission(s)	Read & discuss COMD's intent, confirm details
		Identify COMD's mission(s) [who, what, where, why & when] & confirm
	Identify, analyse & list tasks	Identify, discuss & list tasks
		Identify & list essential, specified & implied tasks
	Identify & analyse Freedom of Action (FoA)	Discuss limitations (constraints & restrictions), actions available to achieve the intent, & essential actions
		Discuss acceptable degree of risk
	Identify & analyse critical facts & assumptions	List facts
		List assumptions
		Discuss unknowns
	Critical vulnerability analysis & Decisive Point identification	Discuss, analyse & list critical vulnerabilities for enemy and own forces
		Discuss & list decisive events
	Confirm COMD's guidance	Develop threat COAs
		Confirm COMD's intent (purpose, method, endstate) & mission(s)
		Outline deception objective
		Outline COMD's priority Int needs or Critical Information Requirements (CCIRs)
		Confirm acceptable degree of risk
		Outline time plan for orders
		Outline Concept of Operations [ConOps] (the where, when & how of manoeuvre)
		Issue WNGO (warning order) / R & S frago (fragmentary order)
COA development	*Confirm COG*	Confirm own & en COGs
		Relate COGs to COMD's intent
	Refine critical vulnerability analysis	Discuss critical vulnerabilities & target en critical vulnerabilities
		Discuss strength comparisons (force ratio)
	Refine decisive events & lines of operation	Conceptualise approaches
		Identify, analyse & visualise doctrinal options
		Identify how to exploit critical en vulnerabilities
		Confirm decisive events
		Construct defeat mechanism
		Develop phase lines
	Develop COA scheme of manoeuvre	Discuss & list objectives
		Discuss main effort
		Discuss support needs & efforts
		Discuss C2, tasks & logistics concepts
		Position initial forces
		Establish details of operation (what, when, where, why & how)
		Synchronise each COA for troops to task, time & space
		Prepare statements & sketches

Table 2 cont'd

Category	Sub-category	Behaviours
	Test COA criteria	Check suitability with respect to COMD's intent
		Check feasibility with respect to time, space, & means
		Check acceptability with respect to cost & risk
		Check distinguishability with respect to other COAs
	Brief COMD	Brief the COMD on potential COAs
COA analysis	*Determine wargame (WG) start state*	Decide when to start
		Position blue forces
		Outline critical assumptions
		Outline known critical events & DPs
		Relate known critical events & DPs to NAIs and TAIs
		Outline significant factors
	Select wargame method	Choose type of wargame
	Select wargame record	Sketch, narrative, synch matrix
	Conduct wargame	Conduct WG drill until each critical event has a decisive outcome based on friendly action, enemy reaction, & friendly counteraction
		Staff identify assets needed for each of these
		Confirm NAIs, TAIs, & DPs
		List advantages & disadvantages, risk, & contingency & support plans for each COA
	Compare outcomes	Compare outcomes of wargame
	Brief COMD	Brief the COMD on outcomes
Decision & Execution	*Compare COAs*	Key staff compare COAs
		COS leads group comparison of COAs
		Select COA to be presented to COMD by staff
	Select the COA	COMD selects the plan to be used
		COMD selects other COAs as contingency plans
	Develop & issue plan	Prepare & issue a confirmatory WNGO
		Develop Decision Support Overlay (DSO)
		Develop Synchronisation matrix to include NAIs, TAIs, DPs, branches & sequels, log sequels & supporting plans
		Develop plans & supporting plans
		Prepare & issue orders (OpOrd)
	Execute the plan	Put plan into effect
		Ops staff monitor current battle (mission analysis to monitor changes in situation)
		Plan adjustments made via combat or quick MAP methods
		Plans staff plan next battle
		Command staff coordinate capabilities & assist COMDs decision making

Clearly, in Table 2 the guidance for planners is structured and involves a stepwise series of processes designed to lead the staff to the best strategy for achieving the mission goal(s) and intent.

What should be taken into consideration is that these behaviours are listed within categories for the purposes of the taxonomy table and clarity of instruction to planning staff. It has been observed by researchers in this area, however, that

(a) the categories are not often exhibited mutually exclusively during the planning process, and
(b) observed and reported planning behaviours differ markedly from those prescribed by doctrine (Pew and Mavor, 1998).

This issue has been examined via an extensive review of the relevant literature by Fallesen (1993), with some key attributes of tactical planning emerging from the literature. These include:

(a) Poor management of the planning process itself which is at least partially due to the unclear role of the commander in the current doctrine as well as inadequate coordination of planning staff;
(b) Lack of exchange of critical information across staff members or a failure to seek the necessary information (Thordsen, Galushka, Klein, Young and Brezovic, 1989);
(c) Shortcomings in the situation assessment process including fact verification, weighting and consideration failures, as well as lack of predictions and interpretation of information;
(d) In terms of COA development, the management and tracking, non-doctrinal COA generation[2] and lack of detail in the COAs generated can be problematic;
(e) COA analysis and selection deviates from doctrine (with the early decision on a COA being one example here); and
(f) Problems occurring with plan monitoring and replanning if battle progress tracking is not adequate, because the failure or amazing success of the chosen COA will not then be quickly noticed.

That is, although the deliberate MAP appears to be a prescriptive process, the behaviours within each category tend to occur throughout the planning process as they are needed by the staff, rather than at predetermined "stages" within planning. The deviation of the conduct of these processes from the doctrinal version is a commonly appearing theme in the list above. This raises an important issue for planning models in terms of their ability to truly represent the planning process. Serfaty, Entin and Tenney (1988), for example, have proposed that a contentious issue for planning models is the problem of whether to view the planning cycle as an evolutionary process or as a sequence of independent processes.

Viewing each stage as an independent step implies that each is discrete from those before and after it, and that decisions made at each stage are not used to foster the decisions made at other stages (Serfaty *et al*, 1988). Conversely the "rolling plan" concept[3], which is supported by the view of planning as an evolutionary process, implies that understanding of the situation assessment process requires planners to consider potential future decisions and perceptions. It also implies that understanding the option selection process requires consideration of the plans and decisions that may occur in the future. Thus, there is a learning effect in action here that reduces uncertainty in the planning and decision-making processes.

One implication of this information for the study of planning in its various forms (from short and time constrained to long, detailed and deliberate) is that the representation of planning processes in military (and other) subjects can be difficult if the observed

[2] Although this is not necessarily a bad thing, according to Klein (1989, 1994) and Thordsen et al (1989).
[3] Coined by John Cushman (1988), in personal communication with Robert R Tenney.

behaviours do not fit with the predictions generated by the model. In looking at the MAP model, one can design a graphical representation of behaviour over time, with clear phases of behaviour over the course of the entire planning activity. According to the model, then, behaviours within the Mission Analysis category should not occur during the Decision and Execution phase. And this is the same for all categories of behaviour – there should be no overlap.

If for example there were 20 behaviours occurring during the MAP[4], with behaviours 1 to 5 shown in blue being Mission Analysis (MA), 6 to 10 shown in pink being COA Development (COAD), 11 to 16 shown in yellow being COA Analysis (COAA), and 17 to 20 shown in green being Decision and Execution (D&E), then we could expect a graphical representation to look something like Figure 2.

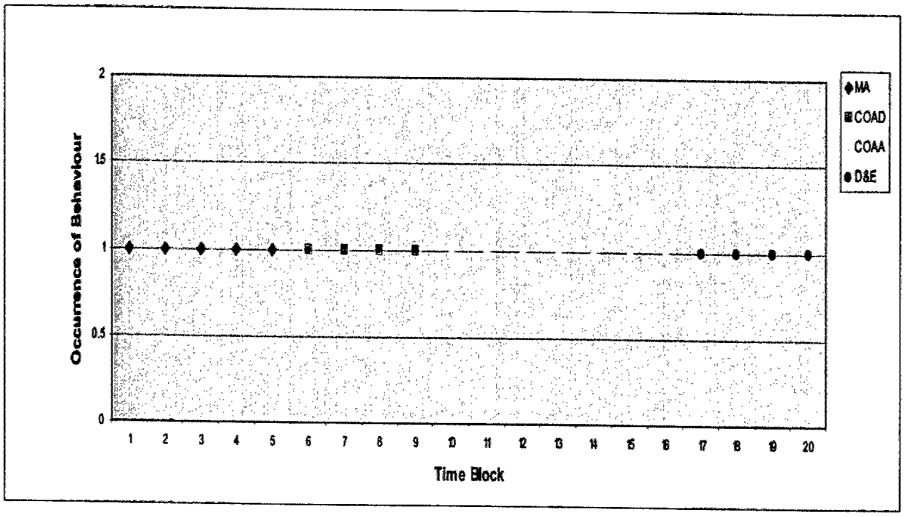

Figure 2: Theoretical representation of the behaviours observed during the MAP

In accordance with the expectations generated by the MAP model, each category should occur in relative isolation from the others.

Part of the current study is to examine the fit of the behaviours displayed by subjects with the predicted appearance of their behaviour patterns based on the MAP model.

[4] This is merely for the sake of example: clearly, there are many more than 20 behaviours occurring during the planning process.

1.2 The current study

The experiment conducted during January 2001 was designed to elicit information about naturalistic decision-making in both military and civilian teams, and compare performance in a Janus wargame under conditions of differing communication architectures.

A planning component was inserted into the study in order to observe the planning methods used when military and civilian teams were placed under severe time constraints. This was aimed at providing a snapshot of the actual methods, behaviours and processes used by planners, and these can be compared with those expected based on the prescriptive MAP model currently in use. The planning component of the study is exploratory in nature, and is used to elicit indications for possible future work directions in this area.

The design, apparatus and data collection are all described in detail in Section 2.

1.3 The focus and aims of this report

This report focuses on the planning aspects of the experiment. For details on findings relating to the use of the Janus simulation to study the naturalistic decision-making, refer to Chapman *et al* (2002).

1.3.1 Aims and objectives

The planning component of this experiment was designed as a pilot study for future larger scale investigations into military planning and the potential enhancement of the process via automation. As such, it is not fully comprehensive nor does it claim to accurately emulate the planning carried out in the field. It is simply a vehicle with which to trigger future issues and studies.

Thus, this work aims to do the following:

- Observe and document the planning behaviours carried out by small military and civilian teams under severe time constraints
- Compare the fit of observed behaviour with the MAP planning methodology
- Use the outcomes as an indicator for the direction of future work designed to specify where technology may be inserted and where it may result in the greatest benefit for the military.

2. Methodology

2.1 Subjects

There were 15 participants in this study, comprising two teams of military personnel (a total of six people) and three teams of DSTO civilian scientists (a total of nine people). The mean age of the participants was 40 years (sd = 8.28).

The military participants were recruited through Major Simon Harvey, with the civilians recruited through a DSTO Edinburgh site email call for experimental subjects.

Participants were randomly allocated into groups of three (within civilian – novice- or military – expert - groups). One team member acted as the commander, while the other two were his/her subordinate sub-unit leaders (one was responsible for the ground force and the other for the support force). The groups of three people in this study represent a simplistic hierarchy, with the roles within each team randomly allocated.

2.2 Apparatus and details of the experimental setup

2.2.1 List of apparatus

This study involved the following pieces of apparatus:

(a) Information sheets
(b) Demographic information questionnaires
(c) Notes to the commanders and sub-unit leaders outlining their roles
(d) Weapon Unit Guide
(e) Weapon illustration sheet (detailing the appearance of units in Janus)
(f) Casualty sheets
(g) Radio protocol
(h) Training protocol
(i) Mission Planning Guide
(j) Intent statement
(k) Planning tools
(l) Video recording equipment
(m) Communication Checksheet
(n) Post Trial Questionnaire

For the purposes of this report, only items (i), (j), (k) and (l) will be discussed in detail.

2.2.2 The planning room layout

As shown in Figure 3, the planning room – which doubled as the commander's headquarters – was outfitted with a large map with talc overlays, a whiteboard, pens and

paper, and a BCSS[5] screen to provide situation awareness updates. The observers were provided a Janus 'God-Screen' (showing all own and enemy force assets locations and activities) behind the whiteboard to facilitate their awareness of the battle progress. All planning sessions were recorded via the video camera placed next to the whiteboard for later viewing by the experimenter.

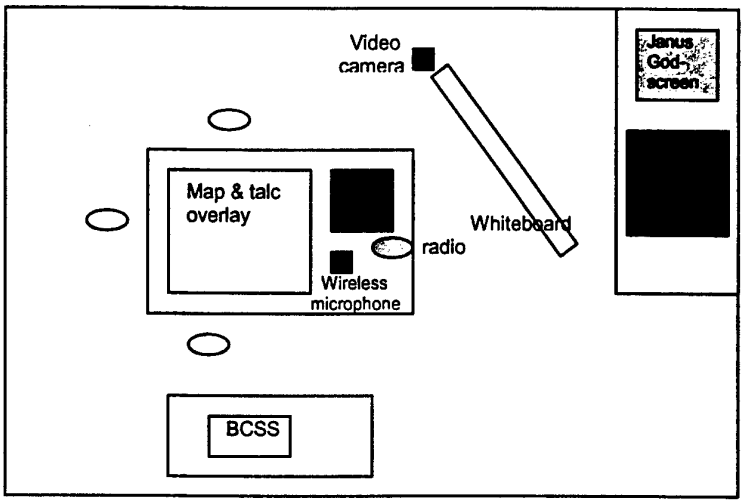

Figure 3: The commander's room/planning room

2.2.3 The Mission Planning Guide

The Mission Planning Guide (MPG) was designed as a result of observation of the first military team during their planning sessions[6]. The guide was given only to the civilian teams prior to beginning their first planning and scenario run, as the military were assumed to have extensive knowledge of this planning process. The MPG can be found in Appendix A.

2.2.4 The intent statement

The intent statements described the goals and desired end states for both of the scenarios. These can be found in Appendix B.

2.2.5 The planning tools

A large paper map of Kamaria (the hypothetical country being defended), corresponding to the area represented on the Janus screen, was laid out on a large table and covered with a clear plastic overlay. Markers, erasers, rulers and other tools were laid out for use in drawing plans on the overlay. Additionally, each team member was provided with a

[5] BCSS is the Battlefield Command Support System.
[6] Refer to Table 4 (section 2.3) for the testing schedule.

colour printout of the relevant section of the Janus screen for ease of reference. Prior to beginning the planning session, the team members were given the initial positions of their weapons, units and assets to facilitate the planning process. Each planning session was videotaped for later viewing by observers.

2.2.6 Video recording equipment

A digital video camera was placed on a tripod near the whiteboard, and attached to a video recorder. A wireless microphone placed on the planning table was used for the audio recording for maximum clarity.

2.2.7 Data recording sheets

Appendix C contains the data sheets used to record planning behaviours during videotape scoring. Behaviours were not pre-entered into the data sheets. Rather, the lead column was left blank and the observer kept the planning behavioural taxonomy on hand, writing in each behaviour as it occurred. The appropriate time interval box was then marked if the behaviour occurred at a later stage. The behaviours were recorded in two-minute intervals using a one-zero method[7], and then totalled and averaged as appropriate for data analysis.

2.2.8 Janus and the networked Computers

The four computers running the Janus program were physically isolated from each other and linked (or networked) for the purposes of the experiment. The command room contained one Janus machine - the 'God Screen' for the observers, which displayed all red and blue entities, movements and locations – which was hidden from the commander. Each sub-unit room contained a Janus machine so that the commanders (COMD) of the sub-units could carry out their duties. The enemy's command room also contained a Janus machine.

The team commander (COMD) did not have a Janus machine: rather, he was provided with a BCSS terminal (BCSS COMD). BCSS COMD was linked to the Janus system via DICE (Distributed Interactive C3I Effectiveness), which enables the presentation of the entities and their movements in Janus on the BCSS monitor[8]. This system provided certain information to the COMD:

- Friendly system/entities were represented and their positions updated on the BCSS screen
- Destroyed friendly units ceased moving on the BCSS screen

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[7] That is, if the behaviour occurred in the time interval, it was marked with a 1. An interval without an instance of a particular behaviour would be left blank and count as a zero.

[8] DICE maps relevant information to a useful Adform and transmits it to a BCSS node where the Adform is converted to an input that BCSS can read and create icons with. This enables the display of events/activities occurring within the Janus wargame to be displayed in BCSS.

Enemy sightings were not represented on the BCSS screen; rather COMD relied on his sub-unit leaders to provide the necessary information which he then transferred to a clear plastic overlay covering the BCSS screen.

2.2.9 Team communications

There were two systems of communication within the teams, and these were alternated between scenarios. The first – open communication – involved all team members hearing all communications. The second – restricted communication – involved the two sub-unit COMDs having to relay communications destined for each other through the team COMD. That is, communication was restricted to the team COMD and any one sub-unit COMD at a time, and the sub-unit COMDs had no direct communication with each other. These conditions are represented by Figure 4, in which GF represents 'ground forces' and FSF represents 'fire support forces'.

This difference in communication architectures was hypothesised to have an effect on the planning process, and so the teams were informed of which communication architecture they would be using prior to beginning each planning session.

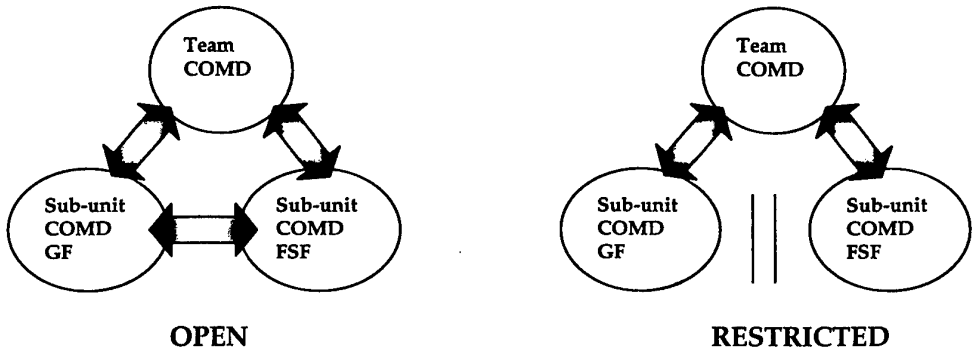

Figure 4: The communication architectures

The results pertaining to the use of the different communication architectures can be found in Chapman *et al* (2002).

2.2.10 Scenarios

Two one-and-a-half-hour-long scenarios were designed for the purposes of this study. They were designed to be of equivalent complexity, but located in different areas of Kamaria.

Each subject group was programmed to run through each scenario four times, providing eight sessions in total. Each team undertook each combination of scenario and communication architecture twice. This is represented in Table 3.

Table 3: Scenarios and their corresponding communication styles for Military Team One

Scenario:	Style of Communication:	No of times combination undertaken by participants:
Scenario A	Open	2
Scenario A	Restricted	2
Scenario B	Open	2
Scenario B	Restricted	2
	Total trials:	*8*

2.3 Procedure

Each team consisted of three people, with one being designated COMD and the other two as sub-unit COMDs for (a) ground force, and (b) fire support force.

The military teams were familiarised with the Janus wargame and its capabilities, and introduced to their interactors (experimental confederates who trained as 'experts' in the Janus wargame and could provide an efficient interface between the military/civilian team member and the computer).

Full details of the experimental method, and example checksheets and information sheets for the subjects are given in Chapman *et al* (2002). The order of testing is shown in Table 4.

Table 4: The testing schedule for the teams

Order	Team
1	Military 1
2	Civilian 1
3	Civilian 2
4	Civilian 3
5	Military 2

2.3.1 Pre-trial information

At the start of the experimental sessions for each group, participants were given a folder containing:

- An information sheet,
- A demographic information survey
- A Janus training protocol,
- An information sheet for their designated role within the experiment,

- A casualty sheet, weapon unit guide, radio protocol, and a diagram of weapon appearances in Janus.

2.3.2 Training

After reading the information provided to them, each team took part in a training session to familiarise them with the specialised set-up of the Janus wargame. Initially participants read through the training protocol, and were given a practical demonstration of the program to reinforce what they had read and increase their understanding. The demonstration lasted approximately 45 minutes for each team.

Civilian participants were given an additional training session in the basics of mission planning. This was done by means of the Mission Planning Guide provided to each civilian team prior to beginning the testing. It was provided in order to ensure that the civilians had the basic knowledge of the military planning steps, and any questions they had were answered prior to beginning the testing.

2.3.3 Experimental trials

Each team followed the experimental structure outlined in Figure 5 for their testing sessions.

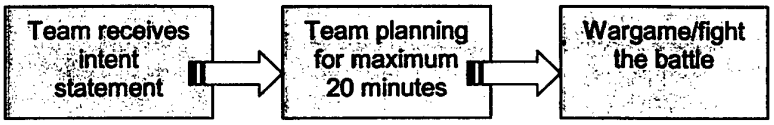

Figure 5: The trial structure for each team

The Janus wargame trials spanned three days for each team following their training session. They completed eight trials in total, with each spanning a maximum of one and a half hours. The criteria for ceasing a trial was one of the following:

1. The mission was accomplished (i.e. all enemies were defeated, and the goal was reached);
2. One of the teams surrendered; or
3. Game play had lasted 1-½ hours[9].

To control for learning effects, the two scenarios were alternated for each trial, as outlined in Table 3. Of the eight trials, four were performed with each communication architecture. To control for order effects, each day and team began under a different communication architecture than the previous one.

[9] This is the length of time needed for Janus to generate meaningful outcome data for later analysis.

2.3.4 Planning

During the planning phase, participants were read the intent statement and then given 20 minutes to work together in planning their mission. To assist with planning routes, tactics and timings, they were provided with a map of Kamaria, a plastic overlay containing grid squares, whiteboard markers, and pens and paper. The participants were observed and videotaped during this stage of the testing.

2.3.5 Wargaming

Following the planning stage, the participants fought the battle using the Janus wargame. The interactors were introduced to the participants, and team members were physically isolated from each other. A radio check was then performed to ensure that every radio was working correctly.

The team COMD was left in the planning room with the maps and overlays used during planning, a BCSS screen showing friendly positions, and a white board (as shown in Figure 3). The two subordinate COMDs were given a room containing a Janus screen showing a map of Kamaria and the positions of their units. The participants were allotted a maximum of 10 minutes to instruct their interactor on the placement of the units and the designation of the movement routes of the weapon units. Once this was done, the wargame was commenced.

During the wargaming the experimenters did three things:

1. Observed interactor/participant interactions (filling in check-sheets);
2. Watched the overall battle picture on the Janus screen and made observational notes; and
3. Listened to the radio transmissions and filled in communication check-sheets.

2.3.6 The post-trial procedure

At the end of the trial, participants were invited to the planning room to discuss their battle. No limits were put on this discussion. After the final trial, they were given the post-trial questionnaire.

2.4 Data Collection

For the purposes of this report, only the behavioural observations taken during the planning stage and their relation to the outcome/performance measures will be discussed. Other methods, findings and analyses are fully discussed in Chapman *et al* (2002) and will therefore not be included here.

2.4.1 Data collection during planning

Initially opportunistic observation and note taking were carried out during the planning sessions of the first military team. That is, eight sets of 20 minutes' worth of observations were conducted in order to obtain a clear understanding of the planning process(es) being used by the military team under these time-constrained conditions. This provided enough information to design the MPG for the civilian subjects' planning 'training', which the civilian subjects were taken through prior to beginning their first planning and scenario run-through. These observations were supplemented and confirmed using information from a MAP training information bulletin (1998)[10].

Note - form observational data were collected during the first of the military planning sessions to ensure that all behaviours being exhibited by the subjects were (a) included in the behavioural taxonomy initially constructed from the steps outlined within the MAP booklet[11] and, (b) that these behaviours were recorded accurately. Each session was also videotaped to allow scoring of the footage using a planning behaviour checksheet and the list of planning behaviours shown at Table 2 previously. A stopwatch was used to time the behaviours as they occurred. The video scoring checksheet is included at Appendix C, with the data summary sheet shown at Appendix D.

3. Results

3.1 The structure of planning under time constraint

Figure 6 illustrates the essential steps of the full MAP. This is the procedure the military are trained to use when there is a relatively long time period between assignment of a battle or task to a unit, and the actual commencement of battle activities.

Table 5 indicates the behaviours observed in Military Team One[12] during the first constrained planning session. Of note is that in two instances the behaviours displayed fit into more than one MAP category, because they are carried out during more than one phase of planning. This is to be expected when the behaviour is "examine and mark positions on map", as this would clearly be carried out early in the planning process as well as during the wargaming phase when alterations may be being made to the proposed COA(s).

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[10] Details in the reference list of this document.

[11] The MAP bulletin (1998) provides a guideline as to what are the necessary steps, inputs and outputs to the MAP process. The steps were examined and the behavioural components of each phase listed.

[12] Had not previously worked together in a team environment.

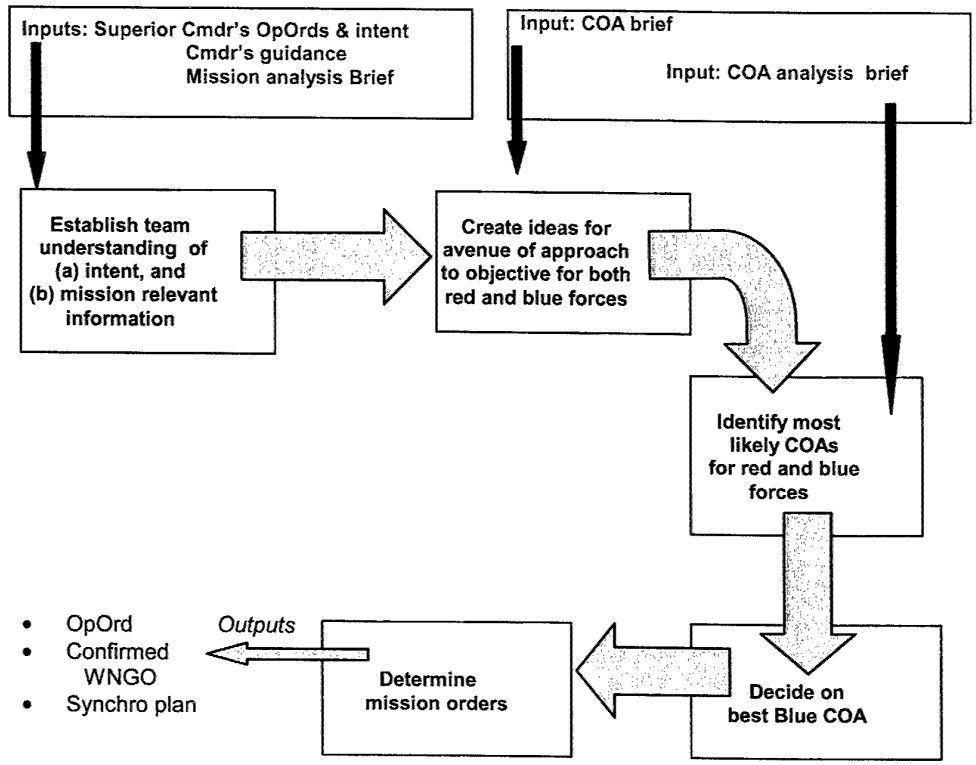

Figure 6: The essential steps of the full MAP

Table 5: The behaviours displayed by Military Team One during constrained planning session one in order of occurrence

MAP Category	MAP Sub category	Observed Behaviour
MA	Identify & analyse COMDs intent	Check intent statement & discuss
MA	Review situation	Check own force assets & discuss
MA	Review situation	Check Int on enemy force
COAA	Determine wargame start state	Discuss start positions & forward line
MA	Review situation	Discuss enemy positions
MA	Review situation	Discuss enemy weapon & sensor asset ranges
MA	Review situation	Discuss enemy tactics & capabilities
COAD; COAA	Refine Decisive Events (DE)& Lines of operation; Conduct WG	Examine & mark positions on map overlay
COAD	Develop COA scheme of manoeuvre	Discuss boundaries
MA	Analyse facts & assumptions	Discuss assumptions
COAD; D&E	Refine Decisive Events (DE)& Lines of operation; Compare COAs	Discuss movement routes & tactics
MA	Review situation	Discuss terrain & effects on own force
MA	Review situation	Discuss timing & time limits for achieving objectives
COAD	Develop COA scheme of manoeuvre	Discuss COAs, plans and groupings of assets
MA	Identify& analyse tasks	Discuss expected necessary actions
COAD	Develop COA scheme of manoeuvre	Discuss order of march
COAD	Develop COA scheme of manoeuvre	Discuss taskings of assets
COAD	Develop COA scheme of manoeuvre	Discuss placement of blue assets
COAD	Develop COA scheme of manoeuvre	Discuss coordination point and phase lines
COAA	Refine Decisive Events (DE)& Lines of operation	Discuss contingencies
MA	Identify & analyse tasks	List troops and taskings

The behaviour profile for constrained planning appears slightly different for Military Team Two, which consisted of LOD military members who had worked together previously in a team environment during experiments and exercises run both at DSTO and at other locations. This is shown in Table 6. Table 5 above shows that there appear to be more instances of the Mission Analysis category occurring for Military Team One (7 of the first 10 observation sets), with the majority of this spent in reviewing the situation. Military Team Two, by comparison, also show 7 of the first 10 observed sets as Mission Analysis (primarily reviewing the situation), but concomitantly show a higher level of COA Development in this same 10 observed sets (that is, six instances compared with the two for Military Team One). Of the final 10 observed sets, Military Team One displayed five instances of COA Development, with four instances of Mission Analysis (two representing reviewing the situation), while Military Team Two showed eight instances of Mission Analysis (with six representing reviewing the situation) and four instances of COA Development (with two representing developing the scheme of manoeuvre).

Table 6: Behaviours observed in Military Team Two during constrained planning session one in order of occurrence

MAP Category	MAP Sub category	Observed Behaviour
MA	Identify & analyse COMDs intent & missions	Discuss mission
MA	Confirm COMDs guidance	Discuss COMDs information needs
COAD	Develop COA Scheme of Manoeuvre	Discuss tactics
COAD	Develop COA Scheme of Manoeuvre	Discuss movement routes
MA; COAD; COAA; D&E		Discuss potential problems
COAD; COAA	Refine DEs & develop line of operations; Conduct WG	Propose & discuss COAs
MA; COAD	Review situation; Confirm en COG	Discuss possible enemy locations & COG
MA	Review situation	Discuss enemy sensor & weapon asset ranges
MA; COAD	Review situation; Develop COA Scheme of Manoeuvre	Discuss enemy tactics
MA	Review situation	Discuss enemy assets & locations
MA	Review situation	Discuss Int
MA	Review situation	Discuss possible enemy knowledge or intent
MA	Review situation	Discuss map and size of AI
COAD	Refine DEs & develop line of operations	Discuss potential own force tactics & actions
MA	Review situation	Discuss terrain and effects
COAD	Refine DEs & develop line of operations	Discuss desirable own asset locations
MA; COAD	Review situation; Develop COA scheme of Manoeuvre	Discuss own asset taskings & capabilities
MA; COAD	Review situation; Refine DEs & develop line of operations	Discuss distances
COAD	Develop COA scheme of Manoeuvre	Discuss possible COAs
COAD	Develop COA scheme of Manoeuvre	Outline alternatives for actions
MA; COAD	Critical vulnerability analysis; Refine critical vulnerability analysis	Discuss priority targets
MA	Review situation	Label areas of reference & objectives on map overlay
MA	Review situation	Discuss Target Designation Points or markers (TRPs)
MA	Review situation	Clarify terms for ammunition
MA	Review situation	Confirm communication architecture
MA	Identify & analyse tasks	List tasks
MA	Review situation	Discuss weather, time of day, etc

The COA development and analysis behaviours conducted early in the planning session resulted in the early adoption of the working COA. Both military teams show the distinct tendency to conduct COA development throughout the planning session, indicating that a potentially feasible COA is selected early on and 'worked on' throughout to produce the working COA, which is then implemented during battle. Figure 7 shows the basic steps followed by the military participants during their planning sessions, with clear overlaps of all the steps to indicate the ongoing nature of many behaviours.

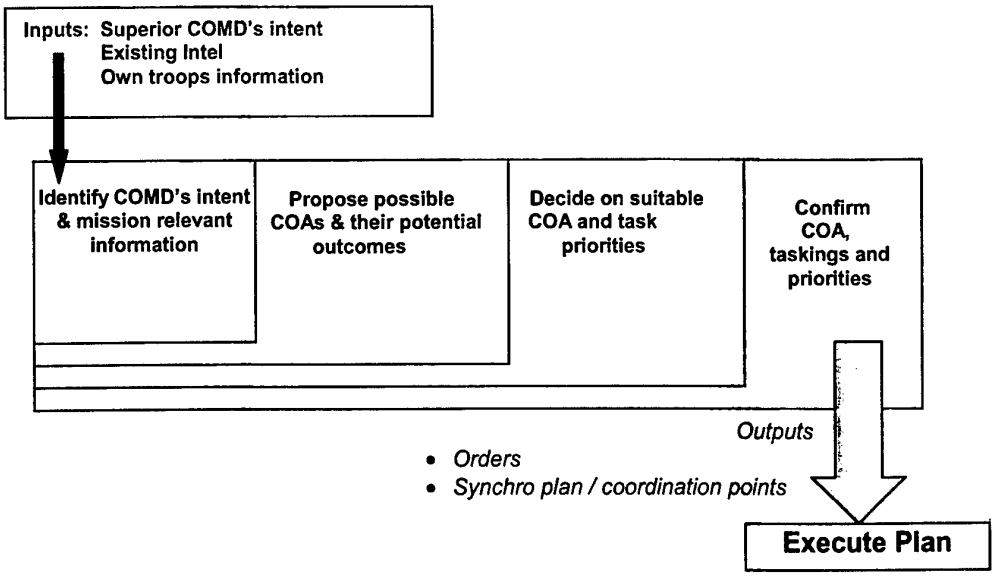

Figure 7: The basic steps of the time-constrained planning observed in the military participants (both teams)

The proportions and orders of behaviour exhibited by the first civilian team are different again to those shown by the military teams. Table 7 shows a tendency to concentrate on the COA development type behaviours, following the initial concentration on the confirmation of tasks, missions and existing information (intelligence). As was observed in the military teams, there is no definitive 'decision and execution' phase evident, with the staff moving directly from 'tidying loose ends' to the implementation of the plan in battle. This included activities such as listing troops and taskings, reviewing the weather and time of day of operations, and the discussion of possible consequences.

Overall the civilian teams showed similar patterns to those of the military participants, which was to be expected due to the planning briefings[13] given the teams prior to beginning their own planning sessions. The difference appears to be that the civilians showed something of a learning curve, and their performance improved overall over the course of the eight scenario runs. This will be discussed fully in the next section.

[13] Based on Military Team One's observed behaviours and the MAP bulletin (1998).

Table 7: Observed behaviours in Civilian Team One during the first constrained planning session in order of occurrence

MAP Category	MAP Sub category	Observed Behaviour
MA	Review situation	Discuss Int
MA	Identify & analyse COMDs intent & mission	Discuss mission
MA	Review situation	Discuss enemy locations
MA	Review situation	Discuss civilian information
MA	Identify & analyse COMDs intent & mission	Discuss intent statement
MA; COAD	Review situation; Refine & target enemy's critical vulnerabilities	Discuss identification of enemy
COAD	Develop COA scheme of manoeuvre	Discuss tactics
COAD	Refine Decisive Events (DE)& Lines of operation	Discuss movement routes
MA	Review situation	Discuss asset capabilities
MA	Review situation	Discuss terrain
COAA	Conduct WG	Confirm start positions
COAD	Develop COA scheme of manoeuvre	Discuss asset taskings
MA; COAD	Review situation; Refine Decisive Events (DE)& Lines of operation	Discuss map details
COAD	Develop COA scheme of manoeuvre	Discuss assets (numbers, groupings)
COAD; COAA	Develop COA scheme of manoeuvre; Conduct WG	Discuss Area of Interest (AI)
COAD; COAA	Develop COA scheme of manoeuvre; Conduct WG	Discuss timings & time limits for achieving objectives
MA; COAD	Identify & analyse tasks; Develop COA scheme of manoeuvre	Discuss recon
COAD	Develop COA scheme of manoeuvre	Discuss communications & information handling
COAD	Refine Decisive Events (DE)& Lines of operation	Discuss use of smoke for screening
COAA	Conduct WG	Discuss outcomes & consequences

Compared with Tables 5 and 6 (Military Teams One and Two respectively), Civilian Team One shows 8 of the 10 initial observed sets of behaviour were Mission Analysis, with 7 of these being reviewing the situation. Three instances of COA Development were observed. Of the last 10 observed sets, 8 were of the COA Development category, with 6 involving developing the scheme of manoeuvre. Four instances of Mission Analysis were observed (including three occurrences of reviewing the situation), a pattern closer in appearance to that of Military Team One than Military Team Two.

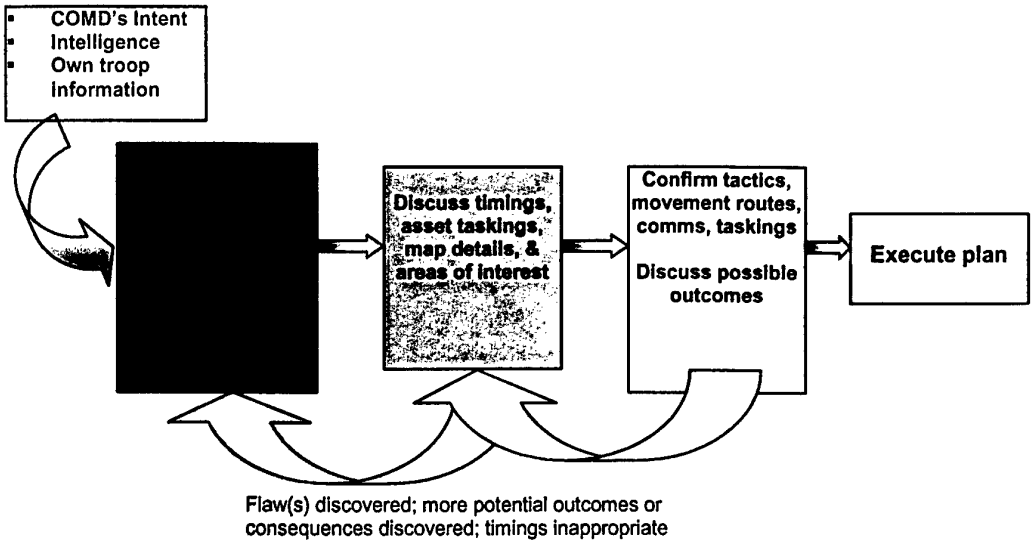

Figure 8: Planning steps for the civilian participants during session two

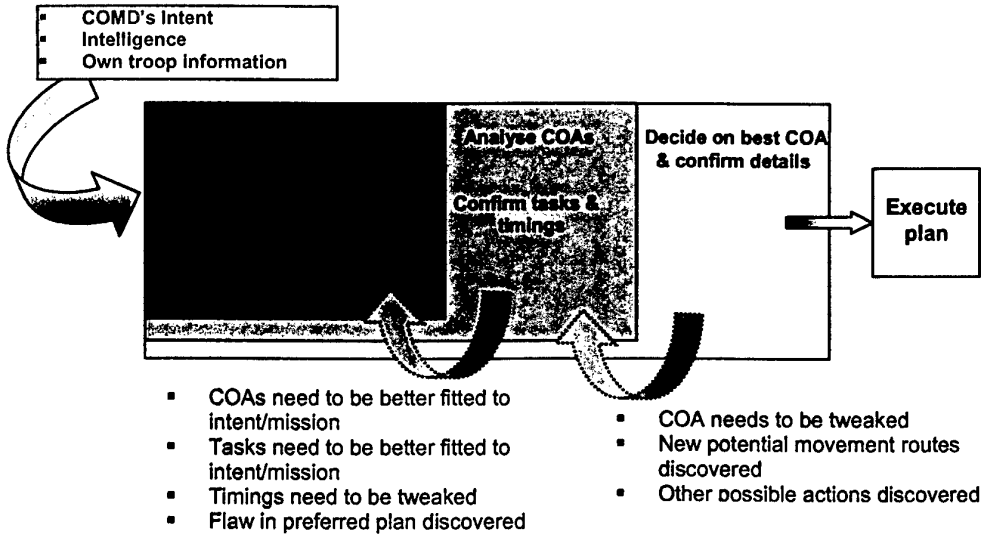

Figure 9: The civilian planning method during session 8. More overlap and less clear-cut steps are evident

Figure 8 and Figure 9 however, show the basic steps followed by the civilian participants during the planning sessions during the second planning session and final planning session respectively.

It can be seen in the next subsection that there are slight changes in the procedures used across time in the civilian teams (particularly in terms of the levels of behaviours from each category), as the first planning sessions were somewhat more confused and less organised than the latter sessions. This can be attributed to the civilians' learning curve,

which emerged because they did not have the advantage of prior in-depth training in the MAP or other planning methodologies (as was the case for the military participants).

It can be observed that the progression of planning steps for the civilian participants is very similar to that of the military. This is expected to a degree, since the civilians were initially acting on the basis of brief instructions given them regarding the basic steps in the MAP process. In terms of the initial inputs however, these were pre-set by the experimenters and were therefore the same for each group, whether civilian or military. The subsequent steps followed by the participants (after the first session) were dictated by their own preferences in planning methods.

Figure 8 is very simplistic, however it does show the essentials of behaviours by the civilian participants in the early planning sessions. It is apparent that there are substantial feedback loops occurring: that is, the participants tended not to think of the preferred plans early in the planning cycle, probably due to their lack of experience in this domain. That is, they did not have the existing knowledge and experience base to rely on when drawing an initial plan of action. This tended to result in more "tweaking" of plans after they had already been tentatively accepted by the subject teams. Figure 9 shows the planning cycle after several sessions (ie. in the 8th session) when the technique has had time to develop through practice.

As with most planning, there is some tweaking of plans and revisiting of certain issues evident in the figures above. The civilian participants' behaviours were relatively rigid in terms of following the prescribed MAP steps/phases, and there was less behaviour category overlap occurring during early planning sessions than was observed in later sessions. This may be due to the civilians' initial attempts to follow very strictly the steps outlined in the MPG (refer to Appendix A for this); this approach was later discarded in favour of a more natural approach. That is, doing things as they need to be done, regardless of what "phase" of planning participants are supposed to be conducting. This may be the manner in which the military evolve their planning process from the rigidly defined MAP - which they are taught as part of their military education – to the dynamic process that experts/experienced military planners display on exercise and during operations.

In terms of staff and commander involvement in the planning sessions, the small teams of three (a commander and two subordinate unit commanders) participating in this study operated as fairly close-knit teams. There was little opportunity for the staff to fall into the standard MAP-dictated 'plan-without-the-commander' method, although on three separate occasions the acting commanders were called away to other activities during the course of a planning session. In these cases, subordinates continued to plan in their absence, and simply briefed them when they returned.

The pattern of behaviour observed in both the military and civilian teams appears to show a closer fit with the Recognitional Planning Model (RPM) methodology than the MAP. This is particularly evident with respect to the tendency for a single COA to be suggested

early in the planning process, and discussion of its pros and cons and actions and potential reactions conducted throughout the remainder of the planning time. This iterates the COA until it becomes a workable plan. In addition, the timelines of the behaviours displayed by the subject teams show clearly that behaviours from earlier phases frequently reoccurred throughout the process, supporting the notion of overlapping "phases" as laid out in the RPM methodology.

3.1.1 The Recognitional Planning Model

Many planning models currently in circulation (such as the Australian MAP and the American MDMP[14]) do not adequately account for the non-linear complexity of the real planning processes used by military staff. These tend not to follow the rigid guidelines set out in such models. Schmitt and Klein (1999) propose a new model for military operations planning which encapsulates the recent work on decision-making and takes into account the actual planning methods used by the military (see Klein, 1998; Schmitt, 1994; Schmitt & Klein, 1996). They have termed this the Recognitional Planning Model (RPM).

The RPM is put forward as a cognitively correct base routine for the planning/command and control process. That is, inasmuch as planners need a routine and will naturally fall into one, they will not necessarily follow the routines in the more singularly prescriptive models proposed thus far. The main aims of this model as stated by Schmitt and Klein (1999) are:

- To accelerate the planning process by arriving at a decision early in the process, and to allow for the fact that time available for planning is usually a major constraint on the process.
- To involve the commander (usually the most experienced person in the organisation) in the planning process from the conceptual design stage, where he can assist in generating higher quality options by contributing creative input, and maximise the creative input of the other most experienced team members.
- To provide a model to describe the way people actually think, decide and behave in naturalistic settings characterised by time constraints, uncertainty, high stress, and shifting goals, and recognise that planning is not a linear, sequential process.
- To exploit peoples' skills and experience instead of limiting these with rigid procedures.
- To minimise the number of handoffs and transitions between different groups (ie. planning group gives plan to operations section, etc) and hence capitalise on the valuable learning benefits gained during the planning process.
- To increase the emphasis on wargaming for plan evaluation and rehearsal prior to execution.

The description above and the model shown in Figure 10 can be seen to be quite similar to the behaviours observed in the participants during the planning sessions in this study.

[14] Military Decision Making Process. Outline in Schmitt and Klein (1999: 2).

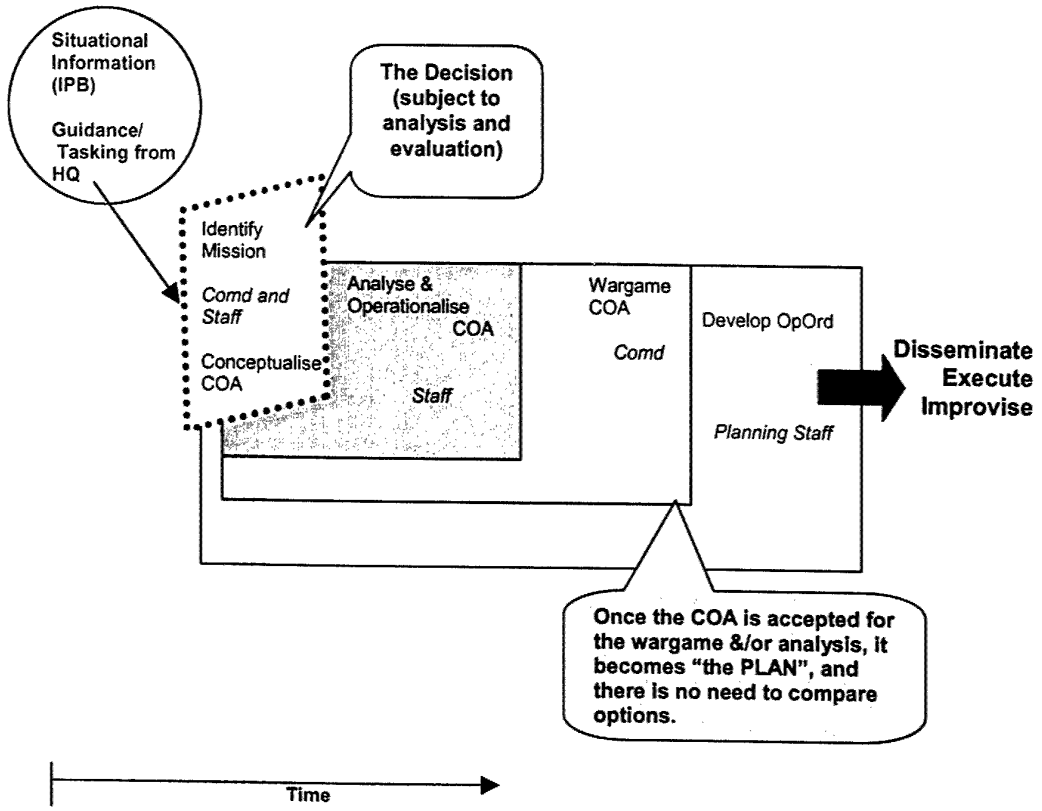

Figure 10: The RPM

Figure 10 shows that although there are clear phases in planning - each of which involves particular procedures – these tend to overlap in time. Therefore, procedures integral to (eg) the *Identifying the Mission/Conceptualising the COA* phase may also occur during each of the other phases. This feature of the planning process is not well accounted for by other currently proposed planning models, although it is commonly acknowledged by observers of the planning process as well as the staff involved in planning.

This RPM is different to the commonly advocated planning models in several ways, but most importantly in terms of both the acknowledgement of overlapping or concomitant "phases", and the early tentative decision on a COA which increases planning tempo and allows more time for parallel planning by the various levels of command. Most currently accepted planning models assume (and prescribe) that planners will first identify and analyse the mission at hand. When this is completed, they will then begin to develop appropriate COAs. This appears to be at odds with what actually occurs in the "real life" setting, where planners tend to identify their mission and concomitantly begin to conceptualise a COA. These two activities are complementary in that the early conceptualisation of a COA can aid the planners' understanding of the problem and its potential solutions. This, according to Schmitt and Klein (1999) creates a tight and continuous feedback loop between the two. Thus, the COA is developed as aspects of the mission are clarified.

Thus, contrary to the tenets of existing models, RPM involves the creation of a single COA very early in the planning process, and it is one that has been quickly identified as the preferred course of action. This appears to be how planners naturally work, as opposed to following the method prescribed by the current models (i.e. generating multiple alternative COAs as dictated by the MAP) that is more difficult and time consuming to accomplish.

The first improvements provided by the RPM are therefore a consequence of the early decision on a tentative COA, and include:

- Facilitation of parallel planning throughout all levels of command
- Acceleration of the tempo of planning
- Continuous improvement of the COA concept and more time to examine the practical implications of the plan during execution

The next "phase" outlined in Figure 10 is *Analyse and Operationalise the COA*. The activities in this phase have already begun during initial mission identification and COA conceptualisation because of the dependence of planning staff on having an initial idea about a plan's feasibility and possible method of execution when conceptualising a reasonable COA. During this phase there is a greater concentration, however, on delving into the *realities* of the COA: this means investigating the necessary logistics and assets and their availability to carry it out, and the fit of the projected outcomes with the mission requirements. An operationalised COA has been examined and broken down into a series of 'components' for the benefit of subordinates. These include the missions themselves, force/asset allocations, command and control (C2) and support unit relationships, objectives and control measures, coordination issues (eg. sequencing and timing), and support plans for other functions (such as fire support, intelligence collection, etc). Since this type of planning is to a large degree mechanical, Schmitt and Klein (1999) envision that automated planning tools may be of value or provide significant assistance to planners. The input of the commander himself during this phase is not critical, and may depend on the size of the HQ in question. That is, smaller HQs may result in greater commander involvement than larger HQs. By virtue of the nature of planning, the decisions begin as coarse-grained, and progressively become more fine-grained over time (as the plan progresses towards the actual details of force allocation, etc).

The *Wargame COA* or "mental simulation" phase is critical to the activities occurring during the first two phases of RPM. That is, the ability to simulate the plan as it unfolds is the means by which the analysis and operationalisation of plans occurs. In the actual *wargaming* phase, this behaviour functions to compare the plan against possible and/or probable enemy actions and (1) fine tune it, as well as (2) allow staff to rehearse the plan. This is where the issues of coordination and alternatives/contingencies are explored and dealt with by planners. Schmitt and Klein (1999) state that if time permits, then several enemy COAs should be wargamed against the developed own force (bluefor) COA.

One of the authors has observed in two separate instances that, during wargaming and under time constraint, a basic enemy approach to key areas will be outlined, and several potential enemy actions affecting the subjects' own forces (their force sizes and movement routes) at key points will be put forward. As each of these is outlined, staff discuss possible reactions and counteractions of own forces and enemy, and a "most feasible" set of actions is elected. This then impacts on the design of the own force COA. A COA that has satisficed against several potential enemy actions can be deemed satisfactory, and will become "the plan"; at this stage, no other COAs will be developed.

Finally, once the plan has been decided, the documents for executing this plan (confirmatory Warning Order [WNGO], the Decision Support Overlay [DSO: outline plan sketch and synchronisation matrix], Operation Orders [OpOrds], plan briefs [if required]) must be produced. As for the other phases, these processes begin prior to the onset of this phase (indeed, usually during the earliest stages of planning). Schmitt and Klein (1999) flag this phase as another in which the provision of automation may provide time benefits in terms of capturing the plans as they are developed and in a format that is amenable to efficient dissemination to other levels of command.

Clearly, the early decision on the probable COA - and its ongoing development throughout the planning process - reflects the behaviours shown by the military teams in this study, and by the civilian teams in their later planning sessions. This may have implications for the training of teams in planning techniques for military (and other civilian work) contexts. This is further explored in the discussion.

3.2 Behaviour levels observed during planning

Please note that the data collected here forms part of an exploratory study designed to elucidate issues and open up potential avenues for future investigation. The amount of data collected and the relatively small numbers do not lend themselves to statistical analyses, and so the results will be presented mainly in a graphical form.

Levels of planning behaviour were observed in the teams across all scenario runs. This was accomplished by noting each new instance of behaviour in each participant during the planning sessions. Only the sessions spanning more than fourteen minutes will be presented in the results however, as there were several sessions only spanning five or six minutes and these are not generally representative of the planning methodology.[15] The data for all sessions were then standardised to twenty minutes so that direct comparisons could be made.

Figure 11 clearly shows that for Military Team One there is a tendency for participants to concentrate the most effort in *Developing the COAs* across the planning sessions. In addition, there is a clear tendency to concentrate more effort on the *Decision and Execution*

[15] These tended to occur when a scenario had been repeated two or three times and the participants were therefore very familiar with what could be done, as they had previously planned their COA and implemented it, thus completing the wargaming aspect of planning during the previous battle.

behaviours during the later planning sessions, probably reflecting the increased time available to the team due to the prior implementation of COAs acting as the wargaming function. That is, prior experience of using a particular COA during a previous scenario run gave the participants an advantage when wargaming the COA for later sessions. The military teams tended to recall earlier planning sessions and COAs during their planning, and then make judgements on the success of the COAs used previously and simply modify them for later scenario runs rather than develop entirely new plans for each one. At its most efficient, this led to a five minute planning session. This is clearly efficient planning given the closely controlled circumstance in which the teams were operating, but would not occur in a field exercise or actual combat situation because there is no such repetition in these contexts.

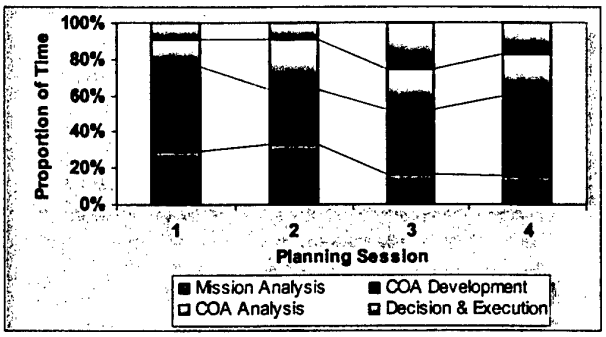

Figure 11: The overall contribution of each planning category during four of the planning sessions for Military Team One[16]

The results for Military Team Two - illustrated in Figure 12– are different to those of Military Team One. Team Two tends to show a much greater emphasis on the *Mission Analysis* and *COA development* phases than Team One. The *COA analysis* and *Decision and Execution* phases are given a minimal amount of effort by this team.

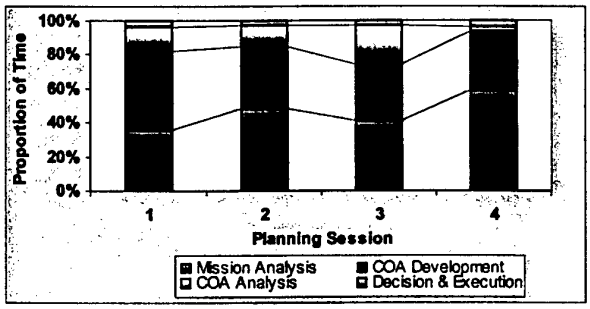

Figure 12: The overall contribution of each planning behaviour category during the four recorded planning sessions for Military Team Two

[16] NB: These numbers represent sessions one, three, six and seven respectively.

This is potentially a product of two issues: (a) the scenario used during session four could have been a repeat for which the team had previously experienced a positive outcome, and so the team decided to employ the same plan as was used on the prior occasion, or (b) the planned strategy was the same as a previous one and had already been considered in depth during the *COA analysis* process. Additionally, some of the behaviours assigned to the *COA analysis* category may have been subsumed within the *COA development* category, as was observed on a number of occasions. Indeed, this is illustrated in the next section (section 3.2.1).

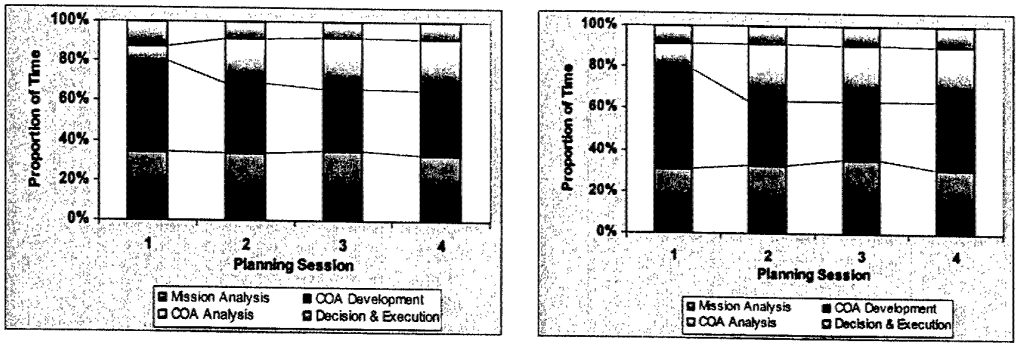

Figure 13 a and b: Planning behaviour levels in Civilian Teams One and Two[17]

Civilian Teams One and Two (in Figure 13 a and b), by contrast, show remarkable similarity in the levels of each category of behaviour shown during the observed planning sessions. They both show a distinct tendency to concentrate on the *Mission Analysis* and *COA Development* behaviours, with less than 20% of their behaviour accounted for by the *COA analysis* and *Decision and Execution* behaviours. The lack of these two categories in the first planning session of each civilian team may be accounted for by the misjudgement of time allocations. In other words, they may simply have run out of planning time. There is a drop in the proportion of time allocated to behaviours in the *COA development* category following planning session one, possibly due to the realisation of the need for better wargaming (and consideration of consequences and outcomes) and finalising of plans for implementation.

Individual differences can also partially account for the different emphases on behaviour categories during the planning process. Commanders tend to bring their individual styles and techniques to their job, and so in small teams such as those studied here, small individual differences in technique may be exaggerated. These differing modes of operation will be expressed during the performance of assigned tasks, and result in different behaviour profiles for each team. This is especially noticeable between the military and civilian teams, as the experience of the military participants means that they can be more flexible in their use of the planning behaviours available to them. In other

[17] Figure 13a planning sessions 1 to 4 represent actual planning sessions 2, 3, 5 and 8 respectively. For Figure 13b, they represent actual sessions 1, 2, 6, and 8 respectively.

words, they may be more successful in combining the individual behaviours into other categories than novice (civilian) participants.

3.2.1 Individual planning sessions: the contribution of each category across time.

The results for Military Team One are presented in Figure 14 and Figure 15.

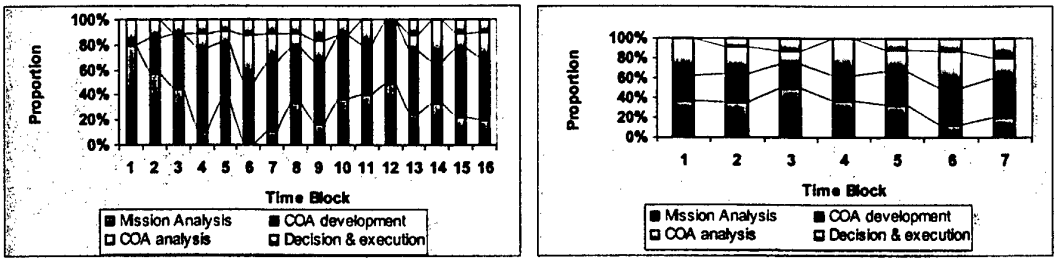

Figure 14 a and b: Military Team One phase breakdown for planning sessions one and three. NB: each time block represents two minutes for these figures

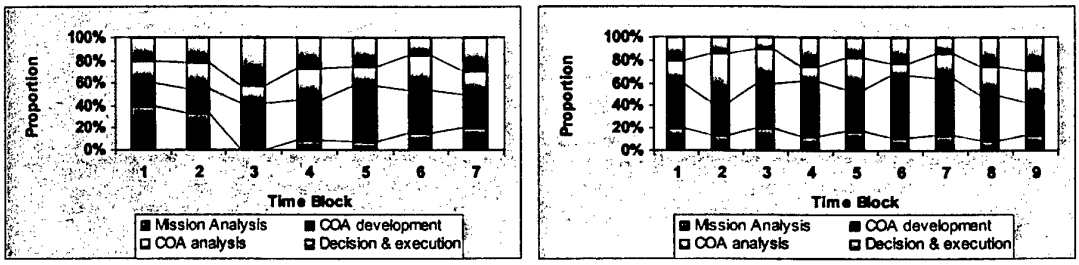

Figure 15 a and b: Military Team One phase breakdown for planning sessions six and seven

Military Team One showed a tendency to quickly establish the mission and commander's intent, and then spend a large proportion of time on the development of the COA. The level of COA Analysis occurring throughout the sessions was relatively small by comparison, particularly in planning session one. In later sessions, the proportion of time spent on Decision and Execution tends to increase. This was due to the increased amount of time the team spent issuing and confirming orders to/for each other.

There is one theme evident in the figures above, and this is the recurrence of behaviours throughout the assigned planning time. That is, behaviours from the Mission Analysis category – which forms phase one of the MAP – occurs throughout planning to various degrees for all the teams, as do behaviours from the other phases of the MAP. COA development can be seen very early in the planning process, indicating that team members are looking to choose a rough COA early on and develop that one rather than create several alternatives to be chosen from at a later stage[18]. So planning is clearly not a linear

[18] The impact of the very short time available for planning should be considered here: further work should be conducted to assess whether this can be generalised to longer planning sessions.

process from phase one through to phase four of the MAP model. This pattern is supported by the results for Military Team Two, shown in Figure 16 and Figure 17.

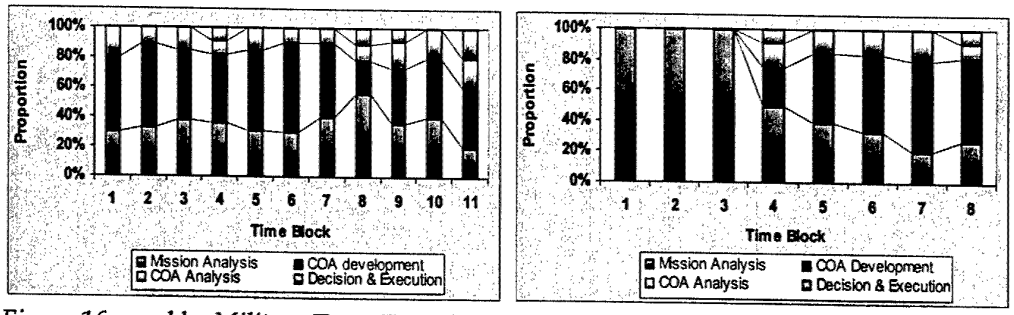

Figure 16 a and b: Military Team Two planning session one and two breakdowns

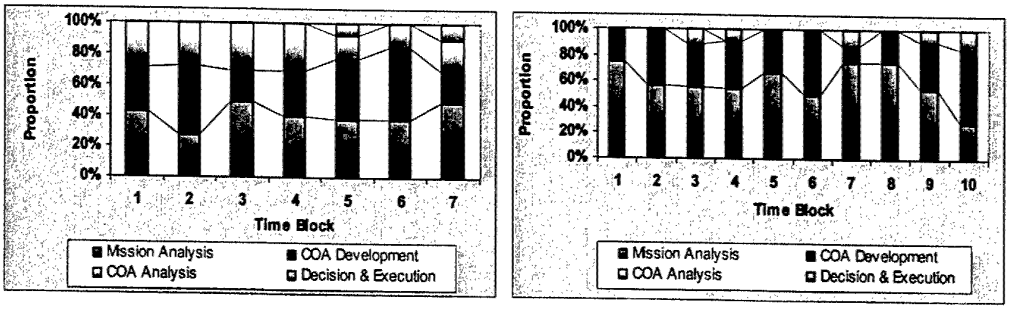

Figure 17 a and b: Military Team Two planning sessions three and four

Overall, Military Team Two appears to put greater emphasis on the mission analysis phase of the MAP during these short planning sessions. This may be because there was a greater concentration in this team on outcomes as a result of previously used tactics, and the information learned about the enemy up to that time. In addition, they show a tendency towards high levels of Mission Analysis type behaviours throughout each planning session when compared with Military Team One. There was considerable clarification and confirmation of the requirements of the mission occurring, after which the COA Development activities appear to take the majority of the remaining time.

In terms of the planning model which best represents the processes being used during planning, the RPM appears to provide a better, more accurate depiction of what actually occurs during the course of this activity. This is supported by the results of the Civilian Team Two planning sessions as illustrated in Figure 18 and Figure 19.

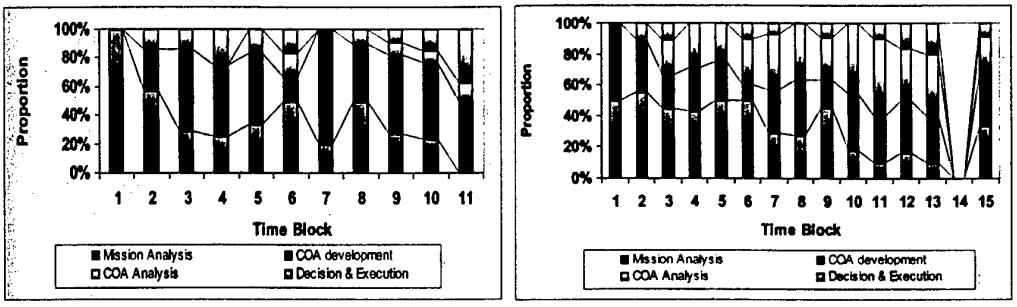

Figure 18 a and b: Civilian Team Two planning sessions two and three respectively

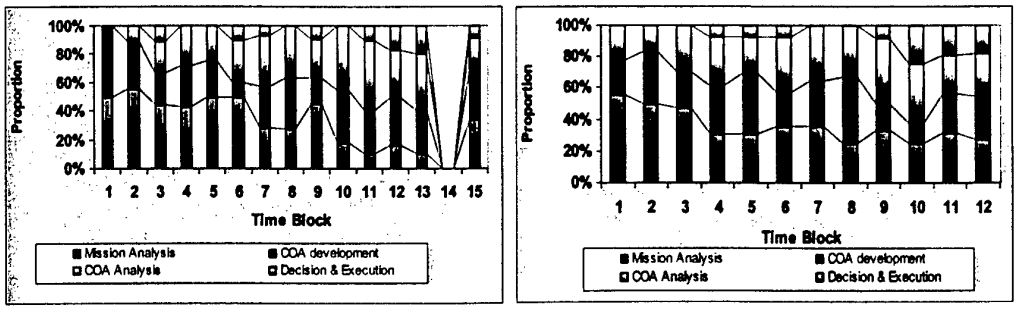

Figure 19 a and b: Civilian Team Two planning sessions five and eight respectively

Clearly there is a developmental or learning curve occurring in both civilian groups two and three as evidenced by the changing proportions of behaviour shown throughout the planning sessions (illustrated in Figure 18 through to Figure 21 respectively). That is, the planning method used by the civilian participants altered across sessions to include a greater proportion of COA Development across all time blocks, with a concomitant levelling out of the proportions of other planning category behaviours. In other words, the civilians are developing a more natural style of planning as they gain in experience. It appears to fit with the RPM model, and involves a higher level of discussion of actions and their possible benefits and repercussions across the entire time period allotted for the planning activity. That is, even the inexperienced planners tended to use a method that comprised the early proposition of a possible COA, which was then developed and modified to suit the situation and the potential outcomes and consequences.

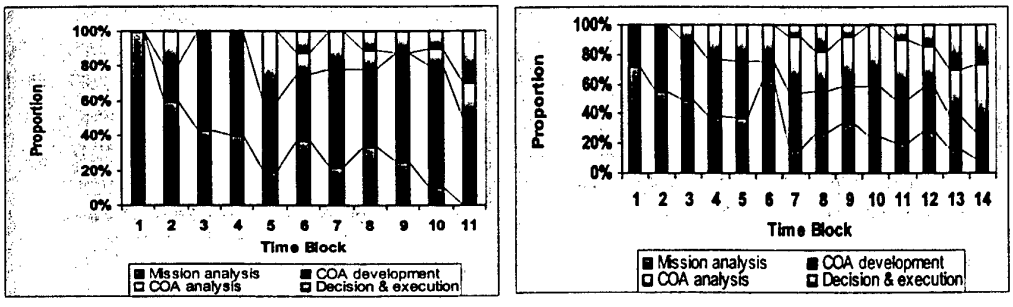

Figure 20 a and b: Civilian Team Three planning sessions one and three respectively

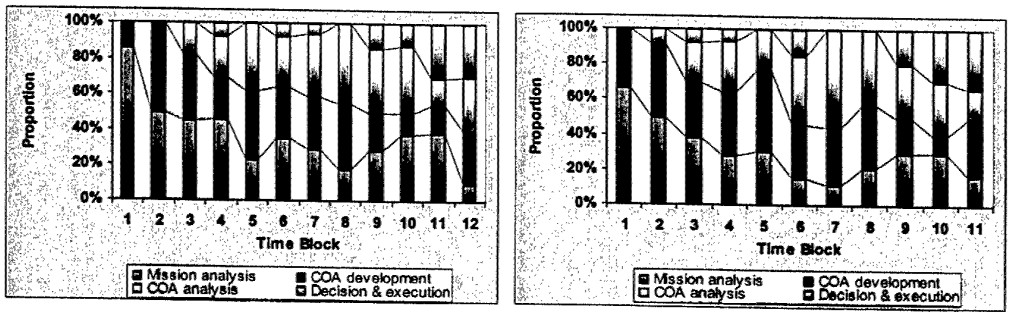

Figure 21 a and b: Civilian Team Three planning sessions six and eight respectively

Thus the RPM-based planning appears to be the structure of planning behaviour that occurs even in relatively untrained subjects. From the figures above, it appears that the rigid planning structure outlined in the MPG (Appendix A) - which was based on the MAP and the military method of planning observed in early sessions - was adhered to only during early civilian planning sessions. As these subjects gained experience and confidence, they tended towards a style of planning that is better described by the RPM, working in such as way that a COA was continuously revised and "tweaked" as new information or potential outcomes were realised during discussions between the commander and staff.

3.3 The outcomes of the wargame

The performance scores per session (this score comprises enemy kills divided by friendly losses per session) are illustrated in Figure 22. This is the performance measure used in Chapman *et al* (2002). This figure plots the available scores (that is, four sessions for Military Team Two) and eight sessions each for two of the civilian teams. Civilian Team One is included, however since a fault in the video recording for this team meant that behavioural data could not be collected there will be no discussion of these scores in relation to planning behaviour. Military Team One were pivotal in refining the Janus scenarios used during the missions, and thus their data were unsuitable for comparison with the other teams, since their scenarios were very different to those used with the other four teams.

When trends in the data are examined, it is apparent that there are no linear relationships between the number of sessions teams had participated in and the performance of the team. That is, more experience did not necessarily lead to better performance. This is supported by the Pearson correlational analysis that was performed on the data, which yielded non-significant results across all teams.

When the performance scores are compared with the behaviour levels during each of these sessions, it is apparent that there are no clear-cut relationships between the proportions of each MAP phase and the performance for the group in each session. This may be a product of the highly artificial situation (in terms of the team compositions, for example) that was constructed for the study. Otherwise, it may simply be that the proportions of

time occupied by individual MAP phases are not good predictors of successful performance in a battle situation, but that the quality of decisions made and the work done within those behaviour categories are actually stronger predictors[19].

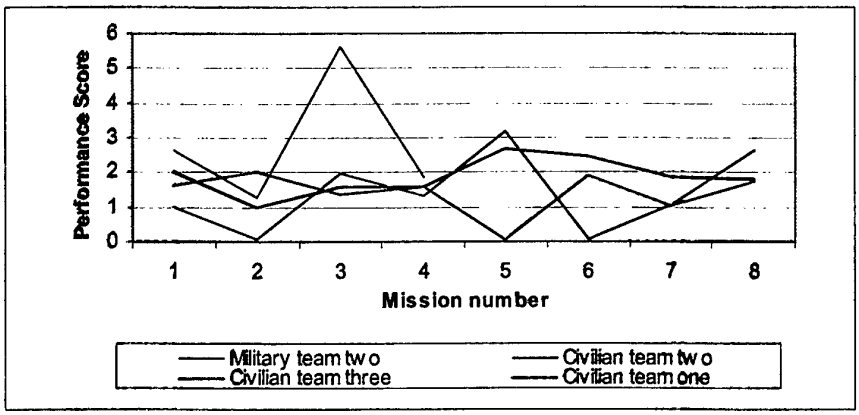

Figure 22: Performance scores for military and civilian teams during each consecutive mission

Further work in this area might clarify the causes and effects here, potentially employing using longer planning times and more complex objectives that mimic more closely the real military situation. Additionally, gauging the scenarios for equivalence in difficulty will also help to confirm the presence or absence of a relationship between these behaviours and the performance scores.

4. Discussion

It is apparent that – when compared with the MAP - the RPM represents the more accurate description of the processes used during planning activities. It appears to lend itself to the fluid way in which planning occurs, and to take into account the fact that the exact way in which planning is done may be different each time it is performed, whether the same team is being examined or not. Put simply, individual behaviours will change according to the needs of the moment, and no two sessions will ever (behaviourally) look exactly the same. The outcomes may, however, be equivalent in terms of successful achievement of commander's intent and mission tasks and goals.

The fit of the RPM with the behavioural functioning of the planners studied here indicates a potential need for the updating of training methods for the military. A strong training

[19] Intuitively, the quality of decisions made has a relationship to the outcomes of the wargame: however quantifying such a measure is difficult and potentially very complex, as a number of factors affect the outcome and laying out simple and useable guidelines for such a thing as "decision quality" may be problematic.

base for planning may be better grounded in more naturally occurring behaviour patterns than a rigidly structured stepwise model. This would be of benefit to staff in terms of their development both individually and as an operationally effective team.

In terms of the levels of behaviour apparent in the participating teams, these did not relate well to the outcomes of the wargames. That is, levels of behaviour here did not form strong indicators of performance (when performance was limited to the kill/loss ratio used here). It may be that this approach is too simplistic and that a broader, more comprehensive methodology is needed in order to delineate these types of relationships.[20]

In terms of the MAP behavioural taxonomy outlined in section 1.1, refinements must be carried out to ensure that the behaviours are representative of what actually occurs. As the list was devised using the MAP training booklet as a basis, there should be further work done in observing and cataloguing behaviours and actions taken by planners, and this should be conducted across all types of planning: that is, short medium and long planning times.

In addition, actions, behaviours and cognitive processes need to be further catalogued and analysed in order to provide a focus for technology insertion into the overall process at the point(s) of greatest effect. This involves a more detailed knowledge of the processes from the point of view of the planner, and also an understanding of the basic underlying cognitive tasks being performed during each of the planning phases or processes. Here, as with the actual battle processes and behaviours observed during exercise Prowling Pegasus (Kardos, 2002: in process), a behaviour systems approach (used in conjunction with cognitive task analyses) may form the basis for an ability to predict the effective insertion of enhancing technology, and may assist in pinpointing problem and error generating processes.

Researchers must seriously consider what it is that they are trying to enhance, and how can it best be done in order to fit in with the cognitive and behavioural functioning of the user of the technology (ie. the planner). It has come to the attention of researchers working in the cognitive arena that supplying humans with "Gucci" new technology which does not fit with their method of mental functioning - or even worse, disrupts it – can be detrimental to the performance of duties and tasks. This disruption can continue beyond the initially expected and acceptable period of adjustment to new tools and technologies, which begs the question: what is the aim of the introduction of these new tools? Many reviews on the use of IT to enhance military functioning are clearly stating that addition of tools and technology "just for the sake of it" can be harmful to the effective functioning of military teams. Mills (2002), in a review of the effects of IT on communication between humans in the workplace, states that there are several ways to optimise the integration of IT into the workplace. Central to implementing IT effectively are the notions of IT supporting the behaviours already displayed and processes used by the staff. Also

[20] It must also be considered that attempting to use behaviour as an indicator of outcome at the higher levels of command may be unworkable. This will be considered prior to the conduct of future work in this area.

emerging from a reading of the paper by Mills (2002) is the notion that taking into account certain needs of humans for the successful conduct of the business of warfighting is essential. Thus, the addition of both a cognitive and behavioural task analysis element to this research to the implementation of the behaviour systems approach (lending a systems perspective to the research) will be vital to the progress of technological enhancements. Future research will be pursuing these avenues.

5. Acknowledgements

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Appendix A: The Mission Planning Guide (MPG)

Mission Planning: Civilian Information.

Prior to planning:

Read and analyse the superior commander's intent statement

During planning:

Review and confirm

- Starting positions for each group (company/battalion/etc)
- General headings for the groups
- Own forces: ie. numbers, elements, weapons, functions of each element, etc
- What is known about the enemy
- What the objectives of the mission are

Evaluate

- The possibilities for movement
- Terrain factors
- Potential enemy movements
- Ability of own troops to achieve the objective
- Risks associated with carrying out certain actions

Develop & Analyse COAs

- Put forward ideas on
  - movement routes
  - locations/routes for recon
  - troop/element groupings or movement formations
- Analyse possible outcomes/consequences of each
- Determine best cost/benefit outcome ratio of possible COAs
- Assign taskings to groups

Confirm

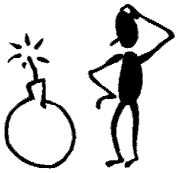
- Mission plan (movement routes, objectives, ROEs, etc)
- Taskings

Post planning:

Commander can write up taskings on whiteboard for reference in the following format:

H Hour:	
Locon 1 (TF1) (name of CO)	**Locon 2 (TF2) (name of CO)**
Tasks: 101 102 103 104	Tasks: 101 102 103 104

==========



Types of actions to consider while planning COAs.

Securing flanks of certain locations/terrain features

Prevent enemy capturing towns/features

Clear flanks of advancing force

Provide fire support to other task force

Securing township(s)

Recon certain areas of interest/areas of potential enemy concentration / features

Provide security to flanks of force

Attack any enemy encountered

Provide support to attacks planned by other task force

Provide indirect fire support

==========

Appendix A cont'd...

Factors to consider while conducting mission planning.

Terrain:

- What type of terrain is around your start positions?
    - Are there areas in which to hide /camouflage your vehicles?
- What type of terrain will you be passing through?
    - Crossing rivers, driving through forested areas, or going uphill will slow your vehicles considerably
    - Roads provide the fastest movement routes, but can be too obvious
- Are there any features you can use to hide behind en route to your objective?
    - Hills, valleys, forested areas can all provide camouflage
- Are there features the enemy may use to hide behind?
    - These features can also hide the enemy's vehicles/troops: think about conducting recon behind/around potential masking features

Initial enemy information:

- What has the enemy done (ie. where are they and what have they just done to get there) and what is their apparent main objective in the near future?
- What enemy assets exist and where?

Own troops information:

- How many of each element do you have at your disposal?
- What are their start positions?
- How do you want your forces grouped?
- What are your element capabilities?

Appendix B: Intent statements for Janus Study

First Scenario

You have deployed in the mountains East of the township of Jalingo to mount an attack to capture the town from the Musorian forces.

Intelligence sources indicate that the Musorian Army has a Coy + Mechanised battle group stationed around the town.

Coordinate your ground, air and indirect fire assets to locate, engage and destroy any enemy elements on your way to capturing the town of Jalingo.

The Musorian Army is believed to have some indirect fire assets located in the town.

Second Scenario

Musorian forces have increased their activities on the island of Kamaria, and are believed to be using the township of Tandaho as a base to launch an offensive on the main city of Lagowa. Local businessmen travelling between Tandaho and Lagowa have reported seeing a number of Musorian vehicles just off the highway between the towns.

Coordinate your combat teams to conduct a search and destroy mission on these Musorian forces before they can establish a stranglehold on the major route between the towns and launch an offensive.

Blue Force

Combat System name	Combat System Type	Weapon Range (km)	Sensor Range (km)	Max Speed (km/h)
M1A1 Abrahms	Main Battle Tank	3	5	66
FCV25	Infantry Fighting Vehicle (wheeled)	2	5	100

Suspected Red Force

Combat System name	Combat System Type	Weapon Range (km)	Sensor Range (km)	Max Speed (km/h)
T-80	Main Battle Tank	4	5	80
BMP-2	Tracked Armoured Personnel Carrier	4	5	80

Appendix B cont'd...

Scenario 9 and 10 Side One unit definitions

Unit ID	System Name	Sys type	Num Ele	Task Force	Num Plows	Num Rollers
1	M1A1	104	4	6		
2	M1A1	104	4	6		
3	M1A1	104	4	7		
4	M1A1	104	4	7		
5	FCV25	191	4	8		
6	FCV25	191	4	8		
7	FCV25	191	4	9		
8	FCV25	191	4	9		
9	FARH1	1	3	11		
10	FARH1	1	3	11		
11	155mm HZR	15	6	14		
12	155mm HZR	15	6	14		

Scenario 9 and 10 Side Two unit definitions

Unit ID	System Name	Sys type	Num Ele	Task Force	Num Plows	Num Rollers
1	155mm HZR	95	6	1		
2	155mm HZR	95	6	1		
3	2S6	363	3	1		
4	2S6	363	3	1		
5	2S6	363	3	1		
6	T-80	396	3	2		1
7	T-80	396	3	2		
8	T-80	396	3	2		1
9	T-80	396	3	3		
10	T-80	396	3	3		
11	T-80	396	3	3		
12	BMP-2	389	3	4		
13	BMP-2	389	3	4		
14	BMP-2	389	3	4		
15	BMP-2	389	3	5		
16	BMP-2	389	3	5		
17	BMP-2	389	3	5		

Appendix C: Video Scoring Checksheets

Date: **Start Time:** **Day:** **Session:** **Group:**

Phase	Time(mins): Behaviour:	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30

Appendix D: Data Summary Sheet

Planning Phase	Session	Duration	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	Total	Standardised for 20 minutes
Mission Analysis																			
COA development																			
COA Analysis																			
Decision & Execution																			
Mission Analysis																			
COA development																			
COA Analysis																			
Decision & Execution																			
Mission Analysis																			
COA development																			
COA Analysis																			
Decision & Execution																			
Mission Analysis																			
COA development																			
COA Analysis																			
Decision & Execution																			

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19. ABSTRACT

The TLCAC study, conducted during January 2001, involved two military and three civilian teams conducting planning activities under time constraint and fighting a battle with a designated enemy using the Janus wargame. This report outlines the planning behaviours observed in military and civilian participants, and briefly discusses their possible relation(s) with the wargame outcomes. It is concluded that the current behavioural results show a stronger association with the Recognitional Planning Model than the military appreciation process, indicating a need for further work in the area and a consideration of the foundation model of planning used.

SYSTEMS SCIENCES LABORATORY
PO BOX 1500 EDINBURGH SOUTH AUSTRALIA, 5111
AUSTRALIA, TELEPHONE (08) 8259 5555